WE CLAIM:

1. A bundle gripping apparatus for picking-up, carrying and depositing stacks of signatures, the bundle gripping apparatus comprising:

a plurality of bundle gripping units each including gripping members for engaging bundles and transporting the bundles to pallets;

an elongate member to which the plurality of gripping units are mounted; and

an adjustment mount of each of the gripping units for changing positions of the units along the elongate mounting member to allow different configurations of bundles and multiple bundles to be transported by the gripping units.

2. The bundle gripping apparatus of claim 1 wherein the gripping units have a predetermined narrow width extending along the elongate member to maximize an operator's view of bundles being transported and deposited on pallets with the gripping units.

3. The bundle gripping apparatus of claim 1 wherein the gripping units each include a housing depending from the elongate member, and the gripping members include a lower support member and an upper clamp member for clamping of bundles therebetween.

4. The bundle gripping apparatus of claim 1 wherein the elongate member is operably connected to an automated manipulator for precision shifting of the gripping units from a predetermined bundle pick-up location to a predetermined drop-off location at a pallet, the

manipulator including circuitry that controls shifting of the units and operation of the units' gripping members.

5. The bundle gripping apparatus of claim 1 including a handle assembly associated with the gripping units and mounting member, and

operator controls that actuate the gripping members for allowing manual control over shifting of the gripping units and operation of the gripping members.

6. The bundle gripping apparatus of claim 1 wherein the gripping members each include a drive system for retracting the gripping members to release gripped bundles and extending the gripping members to a plurality of different extended positions for gripping and transporting bundles of varying heights and configurations.

7. The bundle gripping apparatus of claim 6 wherein the drive systems comprise pulley drive systems each including a drive cable operably connected to one of the gripping members, a pulley carriage having at least two pulleys mounted thereto and about which the cable extends, and a power cylinder for shifting the pulley carriage a predetermined distance that is less than the distance traveled by the gripping members upon operation of the cylinder due to the multiple pulleys carried by the carriages to keep the gripping units compactly sized.

8. The bundle gripping apparatus of claim 1 wherein the elongate member comprises a rail and the adjustment mounts include opposing hanging members attached on the gripping units so that the gripping units hang down from the rail and clamps that releasably fix the hanging

members at a selected position along the length of the rail.

9. A unit for gripping and transporting bundles of signatures having small sizes or large size signatures in use with other units, the bundle gripping unit comprising:

a housing;

a lower support member and an upper clamp member each having a retracted position for releasing bundles (therefrom) and an advanced position for cooperating to support bundles (therewith) for transport (thereof); and

adjustment controls of the support and clamp members for adjusting the position of the members to allow the members to be disposed closer to the housing for small size signature bundles and extended further from the housing for larger size signature bundles to minimize distances bundles project beyond the lower support member.

10. The bundle gripping unit of claim 9 wherein the housing has a top and bottom, the upper clamp member includes a clamping head and the lower support member includes a flat plate, and the clamp member is external and adjacent the top of the housing and the flat plate is adjacent the bottom of and completely in the housing in (the retracted positions thereof) to minimize interference with bundles during pick-up and depositing of bundles.

11. The bundle gripping unit of claim 9 wherein the adjustment control of the lower support member includes a user operated control member and a scale external of the housing, the scale including indicia generally

corresponding to the distance from the housing to which the support member will extend with the control member shifted along the scale to select the desired distance based on signature size.

12. The bundle gripping unit of claim 11 wherein the lower support member includes a cable drive system for shifting the support member between the retracted and advanced positions thereof, the control member includes an abutment in the housing and the cable drive system includes a stop which cooperates with the abutment to limit travel of the support member to the selected extended position thereof.

13. The bundle gripping unit of claim 9 wherein the adjustment control of the upper clamp member includes an extendable slide bar having a clamping head mounted thereto for being shifted from positions closer to the housing to positions extended further therefrom, and the slide bar includes a releasable lock for fixing the bar against sliding with the clamping head at a desired extended position based on signature size.

14. The bundle gripping unit of claim 9 wherein the upper clamp member includes a clamp head and a universal pivot mount therefor to allow the clamp head to clamp flush against bundles having an uneven build-up of signatures therein.

15. A compact unit for transporting signatures stacked into bundles, the unit comprising:

a housing having a top and bottom defining a predetermined housing height, a front and a back defining

a predetermined housing depth, opposite sides defining a predetermined housing width with the width being significantly smaller than the housing height and depth so that the housing is very narrow in the widthwise direction;

an upper clamp member and a lower support member having advanced positions in which the members cooperate to engage respectively uppermost and lowermost signatures in a bundle for clamping the bundle therebetween, and retracted positions for release of the clamped bundles;

transverse linear guides for the clamp member and support member to guide linear sliding movement of the members between the retracted and advanced positions thereof with the upper clamp member shifting transverse to (the advanced lower support member) (11202) for clamping the bundles therebetween; and

power actuators in (the narrow housing) (11202) operable to provide the clamp and support members with a variable range of travel between the retracted and advanced positions thereof for secure clamping of bundles of different sized signatures.

16. The unit of claim 15 wherein (the power actuator for the support member) (11202) has a fast stroke for retracting movement of the support member to minimize the pull on lowermost bundle signatures during bundle depositing operations, and has a slower stroke for advancing movement of the support member to minimize bundle damage during bundle pick-up operations.

17. The unit of claim 15 wherein the clamp member includes a clamp head and the lower support includes an elongate flat plat, and the clamp head travels along the

height of the housing between the retracted and advanced positions thereof and the flat plate travels out from the bottom of the housing in the direction of the housing depth.

18. The unit of claim 17 wherein the elongate flat plate is slightly shorter than the housing depth and narrower than the housing width so that the plate is retracted entirely within the bottom of the housing.

19. The unit of claim 15 wherein the power actuators include fluid cylinders, and cables and pulleys between the cylinders and members, and

pulley carriages each having a plurality of pulleys mounted thereto about which the associated cable extends with the carriages driven by operation of the cylinders to provide the members with a greater amount of travel than the travel of the driven carriages carrying multiple pulleys to keep the housing compactly sized while maximizing the range of travel for the support and clamp members.

20. The unit of claim 19 wherein the cylinders drive the carriages vertically between the top and bottom of the housing, and the pulleys and cables are arranged to cooperate to keep the height of the housing only slightly greater than a maximum height of the bundles to be clamped between the clamp and support members and the width of the housing only slightly greater than that of the carriages carrying the multiple pulleys therewith.

21. A bundle gripping apparatus for transporting signatures stacked into bundles, the bundle gripping apparatus comprising:

a bundle gripping unit having:

a lower support having a predetermined length for fitting under a bundle to be transported;

an upper clamp head having an upper retracted position spaced from the bundle and a lowered advanced position for tightly engaging an upper surface of the bundle and clamping the bundle between the clamp head and lower support thereunder; and

a pivot mount of the clamp head that allows the advanced clamp head to pivot and self-adjust for keeping the clamp head in flush engagement with the bundle upper surface despite sloping of the upper surface.

22. The bundle gripping unit of claim 21 wherein the pivot mount includes a ball joint to allow for universal pivoting of the clamp head.

23. The bundle gripping unit of claim 21 wherein the clamp head includes a disc-shaped member.

24. The bundle gripping unit of claim 23 wherein the clamp member has a predetermined small size, and

an adjustable mounting member to which the small (pivotal) clamp member is attached for allowing the clamp head to be positioned at different extended positions for substantially central engagement with respect to the bundle to maximize the distribution of clamping forces provided by the (small) clamp head throughout the bundle.

25. The bundle gripping unit of claim 24 wherein the lower support member has a retracted position with support member withdrawn from under the bundle and a plurality of user-selectable advanced positions based on size of the bundle to be supported thereby.

26. The bundle gripping unit of claim 21 including hanger members and a support rail from which the hanger members support the gripping unit with the rail having a predetermined length sized to allow multiple bundle gripping units to be adjustably mounted to the rail for handling one or more bundles, the gripping units being spaced from each other along the rail based on bundle size and number of bundles to be simultaneously handled.

27. A method of transferring signatures stacked into bundles to pallets, the method comprising:

providing a plurality of bundle gripping units each including a lower support member and an upper clamp member;

adjusting the gripping units to space adjacent units from each other for picking up small bundles with individual units or larger bundles with two or more units;

shifting the units adjacent to the bundle or bundles to be picked up;

extending the lower support member of one or more of the units substantially fully under the bundle via adjustment of the distance the lower support member is extended depending on the bundle size;

lowering the upper clamp member of one or more of the units for engaging on top of the bundle and clamping the bundle against the lower support member;

shifting the units to a desired deposit location on a pallet;

retracting the lower support member of one or more of the units while keeping the clamp member engaged with the bundle to securely transfer the bundle to the pallet; and

raising the clamp member off of the bundle for further bundle pick-ups.

28. The method of claim 27 including extending the clamp member so that a clamp head thereof is substantially centrally disposed relative to the top of the bundle to be clamped prior to lowering of the clamp member for engaging the bundle top.

29. The method of claim 27 wherein the clamp member includes a pivotal clamp head, and

pivoting the clamp head upon engagement with bundles having signatures unevenly built up therein so that the clamp head self-adjusts with a lower flat surface of the head in flush engagement with the top of the bundle.

30. The method of claim 27 including:

adjusting a variable lifting force provided to the gripping units based on the weight of the bundles; and

automatically changing the lifting force depending on whether there is a bundle being carried by the units and how many bundles are carried by the units.

31. The method of claim 27 wherein the variable lifting force is adjusted based on different weights of bundles generated at different pick-up locations so that different variable lifting forces are provided to the units; and

selecting the variable lifting force to be provided depending on the weight of the bundle being handled by the units.

32. The method of claim 27 wherein the units pick-up more than one bundle at the same time, and transfer the bundles to the pallet one at a time.

33. A method of transporting bundles of signatures under manual control of an operator, the method comprising:

providing a bundle gripping apparatus including gripping members for supporting signature bundles for transport;

lifting the bundle gripping apparatus with a predetermined force either loaded with a bundle or unloaded with the predetermined force independent of the operator-exerted force thereon;

sensing an operator-exerted directional force applied to the apparatus that causes the apparatus to respond substantially the same whether the apparatus is loaded or unloaded by moving in the operator's desired direction of apparatus movement;

sensing an operator-exerted acceleration or deceleration force applied to the apparatus that causes the apparatus to respond substantially the same whether the apparatus is loaded or unloaded by speeding up or slowing down as the apparatus moves in the desired direction of apparatus movement; and

manipulating an unloaded apparatus to a pick-up location for loading the apparatus with a bundle or a loaded apparatus to a deposit location via selective application of the directional and acceleration/deceleration forces by the operator.

34. The method of claim 33 wherein the operator-exerted forces are applied by the operator exerting a pushing or a pulling force on a handle assembly in the desired direction of apparatus movement.

35. The method of claim 34 including providing the handle assembly attached to the bundle gripping apparatus so that the operator-exerted pushing or pulling force is directly applied to the apparatus.

36. The method of claim 33 wherein the bundle gripping apparatus is lifted by a variable lifting force based on the weight of the apparatus and bundles, and

automatically changing the variable lifting force depending on whether the apparatus is unloaded or loaded so that the apparatus does not require the operator to exert a significant lifting force when manipulating the apparatus and application of the operator-exerted forces causes the apparatus responsive movements to be gliding movements in the desired direction of apparatus movement.

37. The method of claim 36 including:

calibrating the variable lifting force for the weight of the apparatus unloaded and loaded with bundles of one weight;

calibrating the variable lifting force for the weight of the apparatus loaded with bundles of another weight; and

selecting the variable lifting force depending on whether bundles of the one or the other weight are to be handled by the apparatus.

38. The method of claim 36 including:

providing the apparatus with sets of gripping members with each set able to support a bundle for transporting multiple bundles with the apparatus for allowing the apparatus to be fully loaded with each set supporting an associated bundle, partially loaded with

less than all of the sets supporting an associated bundle, and unloaded with none of the sets supporting bundles;

providing manually actuated controls for independently shifting sets of the gripping members between gripping and release positions; and

the variable lifting force is automatically changed by actuation of the controls so that the greatest lifting force is provided to the fully loaded apparatus with the controls actuated to shift each gripping member set to the gripping positions thereof, an intermediate lifting force is provided to the partially loaded apparatus with the controls actuated so that at least one of the sets of gripping members for supporting an associated bundle is in the release position thereof, and the minimum lifting force is provided to the unloaded apparatus with the controls actuated so that each set of gripping members are in the release positions thereof.

39. The method of claim 38 including:

sensing the presence of a bundle in position to be supported by one of the sets of gripping members,

enabling the controls for shifting the gripping member set to the support position when the bundle presence is sensed so that the variable lifting force is automatically increased from the minimum lifting force by actuation of the enabled controls.